PUBLIC HEALTH ENGINEERING

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Sewage Treatment Experiments at Houston, Texas—The earliest sewage treatment experiments with activated sludge in Houston were begun about 1914 and have continued since that time. A number of the interesting fundamentals established through this work are given. It was proved that when the quantity of air supplied was less than 0.2 cu. ft. free air per square foot of water surface per minute that there was a noticeable falling off in the results and when the amount of air per square foot was in excess of 0.25 the improvement was not proportional to the quantity of air supplied. Tanks with a depth of less than 7½', with ordinary agitation would not give the best results. The problem of combating the clogging of the filtros plates, due to iron rust, was solved through the immersing of the plates for a few hours in a 10 per cent solution of hydrochloric acid. It is now believed that the use of concrete holders and dust removers for cleaning the air will give the plates a life of at least five years.

The lagooning of sludge (a form of separate sludge digestion) has not been altogether satisfactory. Methods of sludge dewatering were tried. In 1917 the old process of flotation was employed embodying the use of soda ash and sulphuric acid with application of heat to evolve CO_2. The best results were obtained with 105 lbs. of soda ash and 268 lbs. of sulphuric acid per ton of dry product with temperature of 45° C. The resulting sludge, however, had about 97 per cent water, and obviously such a method was not practical. In 1921 a dewatering plant was put into operation which consisted of three cyprus sludge settling tanks of 50,000 gal. capacity each, two plate and frame filter presses and one direct indirect heat rotary dryer. This plant had a capacity of ten tons of dry sludge per day. Attempts were made to filter the sludge directly as received from the aerating tanks and also after acidification with sulphuric acid and sulphur dioxide gas, the final cost of the product being: Unconditioned sludge, $38.90; conditioned with sulphuric acid, $33.85; conditioned with sulphur dioxide, $39.30. The high cost of operating the filter presses and the short life of the filter cloth have caused the abandonment of the process.

A standard wet machine such as used in the paper industry was installed, but cost of replacement of screens, loss of solids, and nonconsistent results caused the abandonment of this process. More recent experiments using a 4-foot American continuous vacuum filter with aluminum sulphate or ferric salts as conditioning reagents have been tried. Hydrogen ion concentration has been used as a guide for the conditioning process. The optimum pH for filtration with ferric chloride is about 5.4 and with alum sulphate is about 4.8. It is expected to produce a sludge cake containing from 80 to 82 per cent moisture at a cost within economic limits and which can be further dried in the rotary dryer. Experiments in 1926 using a conditioning agent and running the sludge so treated on to drying beds for partial drying were not successful, due to climatic conditions and odors and other nuisances produced before the sludge had time to dry sufficiently to be removed from the beds. Other experiments to prevent the rising of sludge blankets in the settling tanks through the use of chlorine were tried. Experiments on the iron content of sludge have indicated that so far as Houston conditions are concerned the iron content has no effect on purification.

Experiments with very concentrated packing house waste indicate that surface aeration by mechanical apparatus is equal in cost of power to that of diffused air. Standard purification was accomplished by the first method in 36 hours as compared to 12 hours with activated sludge. With normal domestic sewages, however, there may be attained a greater power economy using surface aeration.—W. S. Stanley, *Proceedings of Ninth Texas Water Works Short School,* Texas Sec. Southwest Water Works Assn., pp.288–292. Abstr. Chester Cohen.

Occurrence of Bacterium Coli of Intestinal Origin on Hands of Food Handlers—This paper presents the results of an actual investigation made in the public eating places of Waco, Texas, to determine the frequency of the occurrence of *B. coli* of intestinal origin on the hands of food handlers in restaurants, cafes, lunch counters, sandwich shops and soda fountains. The tests used, together with the technical procedures followed, are given in detail. Koser's sodium citrate medium was used for distinguishing the *B. coli* of intestinal origin from that of vegetable origin, since in this medium it appears that the former organisms do not grow while those of non-fecal origin produce a turbidity in the otherwise clear medium.

A total of 337 tests were made on 251 food handlers and the results are tabulated to show the variations among different races, sexes and ages. *B. coli* of intestinal origin were found present on the hands of food handlers while at work in 8.38 per cent of the tests made.—W. A. Buice, H. C. Sehested and R. B. Dienst, *J. Infect. Dis.*, 40:348 (Feb.), 1927. Abstr. W. L. Havens.

Report of a Typhoid Epidemic in Grafton, West Virginia, Winter of 1926–1927—In December, 1926, and January, 1927, Grafton, West Virginia, suffered from a typhoid fever epidemic due to polluted drinking water. There were more than 150 cases resulting in 25 deaths. Grafton procures its drinking water from the Tygarts Valley River, and for five years the West Virginia State Health Department has been urging filtration of the water. Little success has been met and it even was necessary to have recourse to the courts to obtain the installation of a chlorinator.

Investigation of this epidemic disclosed that chlorination had not been continuous nor at a high enough rate during the month preceding. As to the cause of the specific pollution of the river, it was found that five cases of typhoid fever had occurred in the late fall of 1926 twenty miles up the river and that the stools of these patients had been thrown on the banks of a small stream leading to the river. Rainfall records indicated that heavy rains had occurred during the second and third weeks of November, the period preceding the time of development of the greatest number of typhoid cases in Grafton by two or three weeks. The five cases up the river were virulent ones and the disposal of the stools on the bank of the stream leading to the river probably caused the disastrous epidemic in Grafton.

As an outcome of this epidemic immediate steps were taken by the municipality to retain a competent engineer to draw plans for a modern filtration plant and the West Virginia legislature was asked to pass a special emergency bill allowing a special levy to be made to finance a construction program.—E. S. Tisdale, *Pub. Health Rep.*, 42:1217 (May 6), 1927.

Separate Sludge Digestion—The method of sewage disposal by separate sludge digestion is briefly discussed in this article and the operation and construction features of two plants in Wisconsin are described.

The city of Hartford built a plant of this type in 1924 and it has given satisfactory service. Sewage first passes through a coarse bar screen and the screenings are removed to the sludge bed. The screened sewage passes to the clarifier where the suspended solids are removed. A Dorr mechanism is used for concentrating the sludge and the thickened sludge is removed daily to a separate tank for digestion. The average detention period in the clarifier is 2¾ hours and the time necessary for pumping sludge is 30 minutes daily.

The digestion tank has a capacity of 3 cubic feet per capita based on an ultimate population of 5,500. This tank, too, is equipped with a Dorr mechanism for breaking up the scum so that gases may escape. The incoming sludge is distributed evenly on the surface by means of a channel riding with the revolving mechanism.

Sludge is removed by static head to a concrete drying bed. The under-drainage system is of tile with brick covering. Over the brick are placed 18 inches of stone and 6 inches of sand. The area of the bed provides a capacity of 0.6 sq. ft. per capita. Official tests conducted by the Wisconsin State Board of Health established the fact that the raw sewage was extremely strong for domestic sewage and that a removal of 73 per cent by weight of the suspended solids was accomplished. Sludge has been withdrawn five times without any complaints from adjacent landholders. The operating cost of this plant was $630 for 1925.

A similar installation was recently completed at the city of Antigo except that provisions were made for securing better operation during cold weather by the addition of a cover for the digestion tank, a gas collector and heating unit for the sludge. The gas is used as fuel for heating the plant and the sludge, and is

equivalent to 200 pounds of coal per day over a nine months' period. The gas maintains a temperature of 65° F. in the digester.

The following advantages of separate sludge digestion are noted: The tanks are shallow and cheaper to build than two story tanks; the mechanism employed in the tank takes the place of hand work; the type of plant is flexible and capacity of either tank can be enlarged without necessity of enlarging both; the elevation of sludge in the digester permits gravity distribution to drying beds; the collection of gas, when burned eliminates odors and conserves fuel in the plant; this type removes the solids as much as others; the mechanical features need supervision and better efficiency is secured than a non-mechanical plant in which supervision is often neglected.—Jerry Donohue, *Am. City,* 36:633 (May), 1927. Abstr. D. W. Evans.

Purification of Skim Milk Solutions on a Lath Filter—"The problem of purifying creamery wastes resolves itself into developing means of destroying milk sugar without acid production." Anaerobic methods of treatment develop inhibitory acidities and disagreeable odors. Activated sludge methods are costly and do not produce entirely satisfactory effluents. For small creameries especially, lath filters seem eminently practical and produce very satisfactory results according to these experiments which extended over a period of three months.

"In these experiments a small lath filter was employed. It consisted of 6 tiers of laths 2 feet square and 1 foot deep with 4 inch spaces between the tiers to permit sampling at the various depths. Various dilutions of skim milk (0.5 to 1.5 per cent) were applied at rates of 1,125,000 and 2,250,000 gallons per acre per day for 10 to 14 hours daily."

Results for the 3 dilutions and 2 rates of filtration: Allowing for mineral solids in the diluent the filter removed from 63–75 per cent of the milk solids principally in the upper 3 feet of the filter. The reduction in oxygen consumed constituents was from 75.1 to 87.3 per cent and the elimination took place largely in upper 3 feet of filter. Ammonification was most marked in the upper layers of the filter. Nitrites rose quickly to a maximum in the third to fifth foot and then decreased. Nitrite formation was markedly retarded by increasing the concentration or rate of filtration. A distinct reduction in nitrates occurred in the first foot of filter and rose rapidly through the rest of the filter. Although based on few data, the observed relationships between concentration of waste, rate of treatment and nitrogen, point to a direct mathematical one. High nitrates were accompanied by high relative stabilities and, with 1 per cent solution, the effluent from the fourth foot of filter gave relative stabilities of 85–90 per cent. Raw wastes were slightly acid (pH 6.6–6.9) and fresh effluents were distinctly alkaline (pH 7.7–7.9). Anaerobic storage of raw wastes for two days at 20° C. increased acidity (pH 6.4–5.2), while effluents on storage remained alkaline (pH 7.4–7.6).

The pamphlet has charts and tables and the appendix contains tables of original data of seven series of experiments.—Max Levine, G. W. Burke and C. S. Linton, *Bull. 81,* Engineering Experiment Sta., Iowa State College, Ames, Iowa, 25:1 (Sept. 29), 1926. Abstr. A. S. Bedell.

Summer and Tourist Camp Sanitation—Camp sanitation is demanding greater attention due to the greatly increasing auto travel. In 35 states there were 3,000 camps having sanitary inspection and it is estimated that these camps were used by 2,000,000 people in the camping season of 1925. It is, therefore, important to establish safe water supplies along highways and in tourist camps to limit the spread of water borne disease. Thirty states have enacted special rules and regulations to govern outdoor camps. In most states special engineers or sanitary inspectors are employed during the summer months to supervise camp sanitation. A decentralized program of coöperation between the state and local officials seems best for handling the administration of the regulations governing camps.

The general specifications for regulations on camp sanitation of several states have a general agreement and include the following points: (1) Definition of a camp; (2) submission of plans and issuance of a permit; (3) safe water supply; (4) safe sewage disposal; (5) sanitary garbage disposal; (6) proper drainage; (7) capable management; (8) penalty clause. Certification of highway and camp water supplies has been found practical and has been taken up by many states.—*Committee Report* presented at Conference of State San. Engrs., June, 1926. *Engr. & Cont.,* 65:436 (Sept.), 1926. Abstr. C. C. Ruchhoft.

Results of Studies at the Omiya Laboratory for Disposal of Night Soil—The portion of

the report appearing in this issue deals principally with the experimental privies and the longevity of typhoid bacilli therein. The object of the studies was to determine the length of time required for total destruction of pathogens in urine-feces mixtures through natural decomposition and to devise a practical privy which would accomplish this end.

Laboratory experiments showed that the longevity of typhoid in excreta varied from six days in mid summer to 40 days in the spring and fall and that some bacilli would live throughout the winter.

Hookworm eggs lived a month during mid summer and five months during the cold season. Round worms were more resistant, living 2 months during the summer period and sometimes found alive after 10 months.

Several types of privies were experimented with, the most successful being a box shaped type having a capacity of 22 cubic feet (capacity 10 persons for three months) with five sections of chambers. The entrance chamber was considerably larger than the others. This type appeared to give better results than where the chambers or sections were of uniform size.—R. Takono and others, *J. Pub. Health Assn. of Japan*, 3:1 (Feb.), 1927. Abstr. R. E. Tarbett.

Practical Sterilization of Milk Bottles by Chemical Disinfection—The best method of chemical disinfection consists of the use of an automatic bottle cleaner with three soaking compartments containing detergent solutions with alkalinities of 4 and 4.5 per cent (as NaOH) in the first two compartments and clean water in the third, at temperatures of 120°, 160° and 120° F. This was timed for a 4-minute exposure and killed all *B. coli* and maintained proper caustic strength of solutions during cleansing of approximately 15,000 milk bottles. From a number of tests it was determined that a 5 per cent solution of NaOH at 100° F. would destroy *B. coli* in 2 minutes. Na_2CO_3 was not as efficient germicidally as NaOH used alone or in combination with Na_2CO_3. Sodium hydroxide does not destroy tubercle bacilli but the temperature of 160° F. for 4 minutes in second compartment destroys those exposed.—Milton E. Parker, *Pub. Health News*, N. J. State Dept. of Health, 11:296 (Nov.), 1926. Abstr. W. W. White.

INDUSTRIAL HYGIENE

EMERY R. HAYHURST, M.D., AND LEONARD GREENBURG, PH.D

Precautions in the Use of Duco—The occupational poisoning resulting from the use of quick drying finishers including the pyroxylin types has called forth the preparation of this *Bulletin* although but few cases have been actually discovered. The composition of Duco is somewhat less than 50 per cent solids consisting of resins, pigments, flexible oils, and a relatively small amount of nitro-cellulose. The fluid constituents consist of volatile solvents of the alcohol and aromatic series and esters. Duco, like all pyroxylin finishers, and its thinner are highly inflammable. Both Duco and the thinner are free from more than a trace of benzol—0.05 per cent. Duco is used in spray guns and deposits from it or pyroxylin finishers must not be allowed to collect, especially in heated places. No lead pigments are used except in the case of a few shades, but metal primers for use with Duco contain about 30 per cent solids, of which less than one-half is lead or lead salts. Of the surfacers, from 40 to 50 per cent are pigments, of which less than one-half are lead or lead salts. Of the glazing putties from 70 to 80 per cent are pigments, of which about one-half consist of lead or lead salts. In none of these primers, surfacers or putties is there benzol. The various admixtures of the lead salts, used only in a few shades—yellows and greens—are with insoluble materials "so that the probability of contracting lead poisoning even by breathing a lead dust obtained from dry sanding Duco is rather remote." Personal cleanliness is a great factor here. Sanding should be done wet. Putty coats, however, must be dry-sanded, but the surfaces concerned are usually small. Those exposed should wear respirators. The *Bulletin* discusses the preparation of the working surface by sand blasting or a hot caustic solution or phosphoric acid in alcohol. A sand blaster's